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(54) **PATCH ANTENNA**

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CPC ***H01Q 9/0407*** (2013.01); ***H01Q 1/48*** (2013.01); ***H01Q 19/10*** (2013.01); ***H04B 10/40*** (2013.01)

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USPC .... 375/219, 220, 222; 701/469; 343/700 MS

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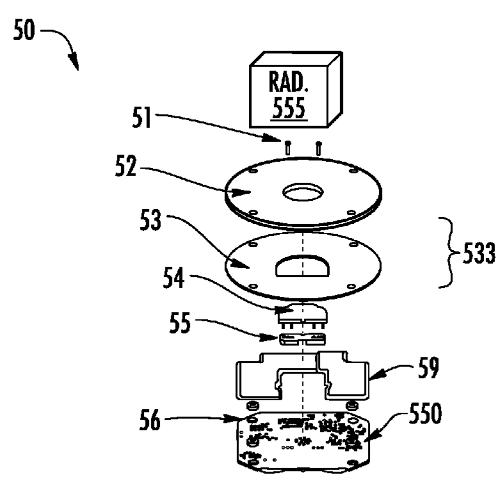
(57) **ABSTRACT**

A terrestrial transceiver is described, which is operable for exchanging RF signals with communication satellites. The transceiver has a patch antenna sensitive to signals within an L-Band RF range and operable for providing a gain to the RF signals. A metallic reflector of a characteristic dimension is operable for shaping a pattern of the RF gain of the patch antenna. A printed circuit board assembly (PCBA) has a dielectric substrate, an electronic component disposed upon the substrate, and a hole penetrating the substrate and disposed substantially within a central region thereof. Based on the dimension characteristic of the reflector and on a positioning and/or a dimension of the hole, the RF gain diverges over an angle from a boresight of the patch antenna.

16 Claims, 8 Drawing Sheets



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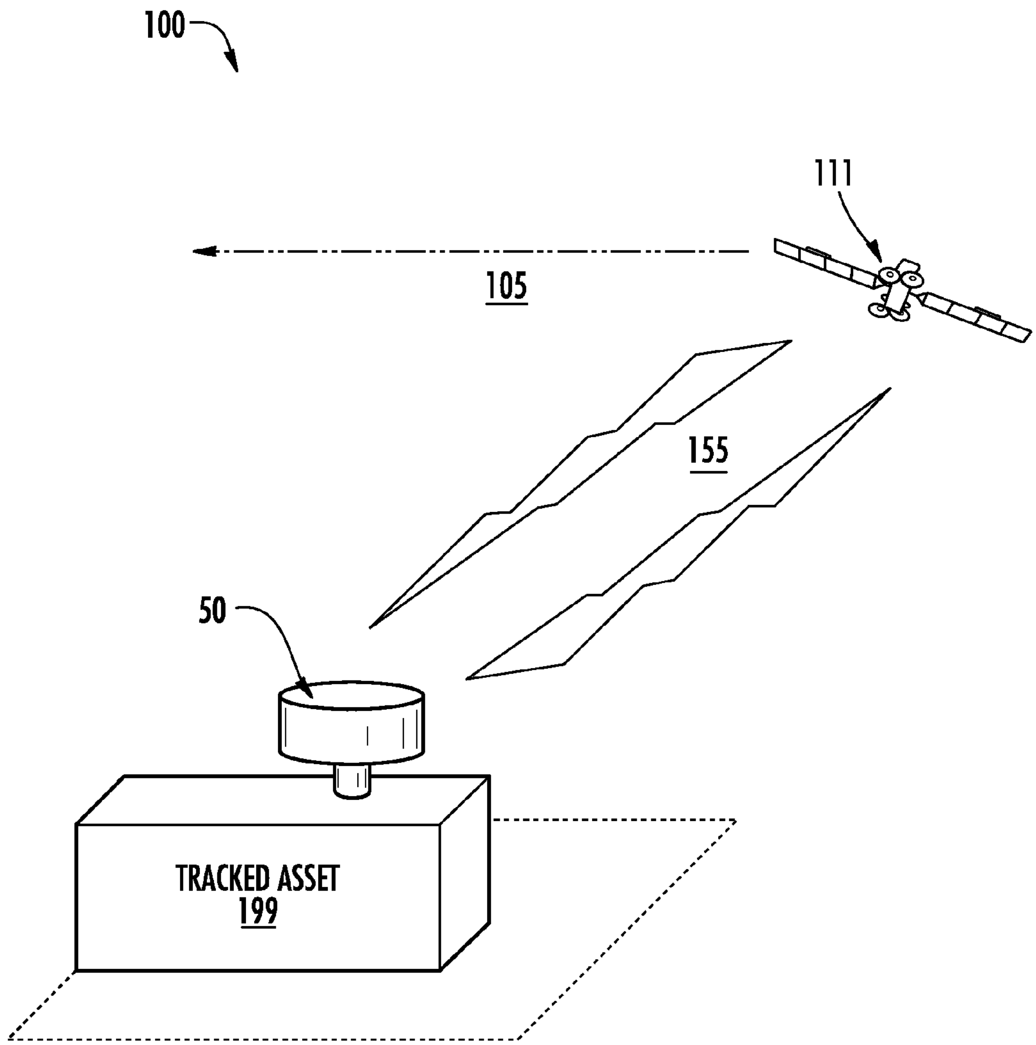

FIG. 1

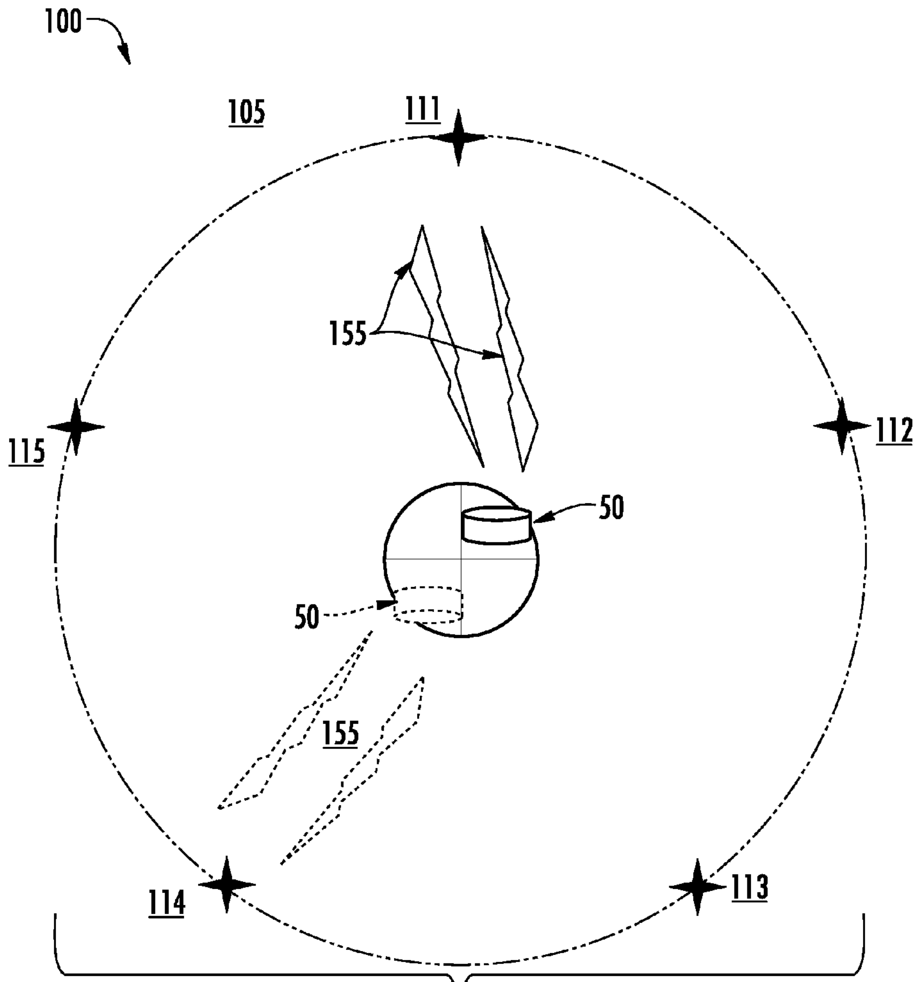

FIG. 2

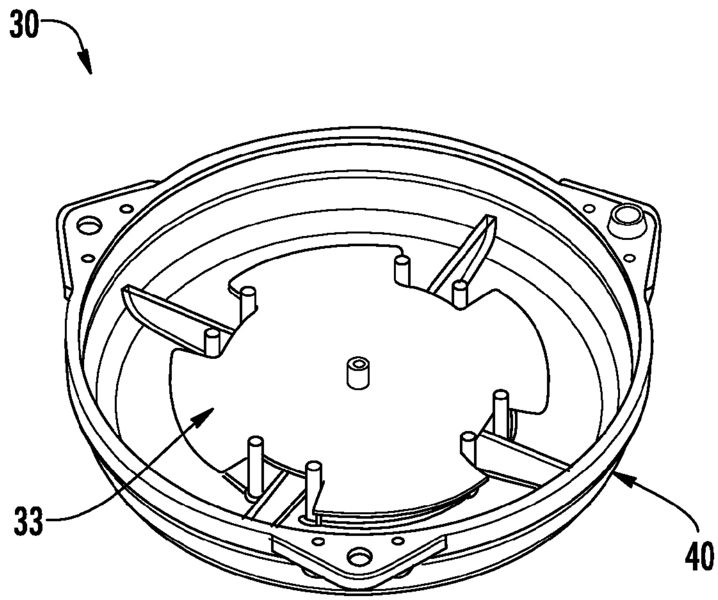

FIG. 3

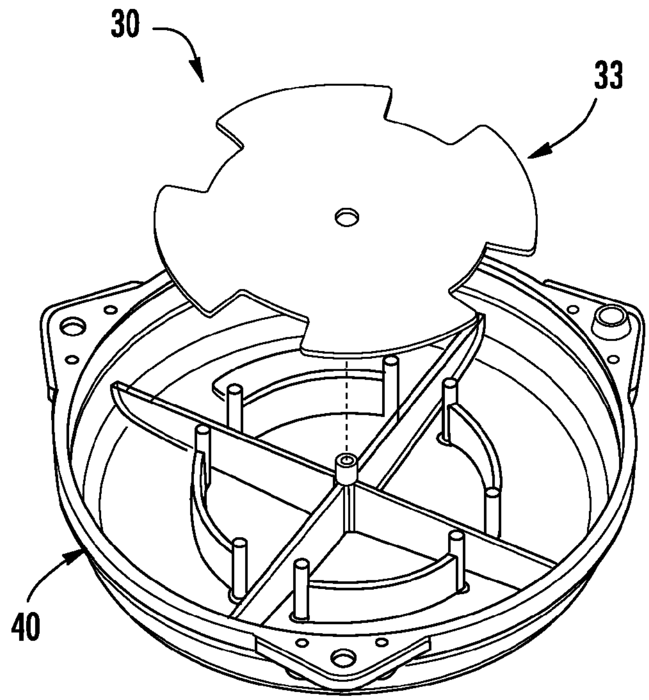

FIG. 4

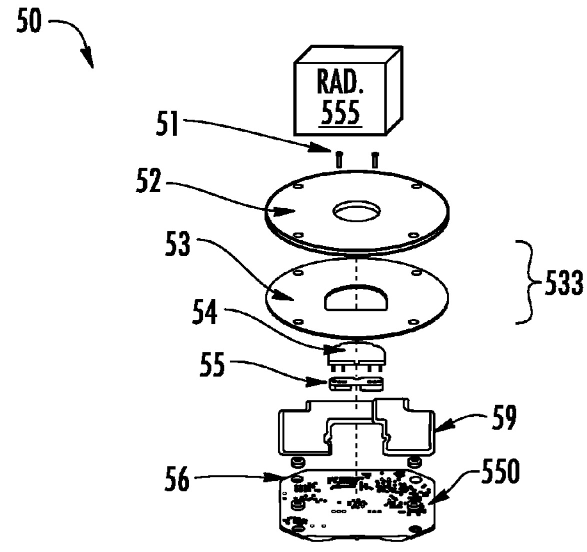

FIG. 5

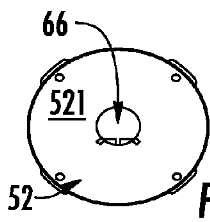

FIG. 6A

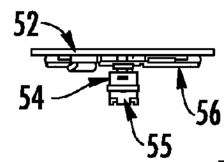

FIG. 6B

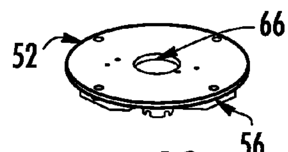

FIG. 6C

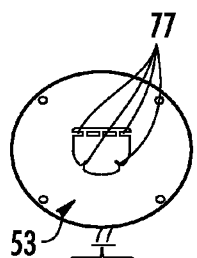

FIG. 7A

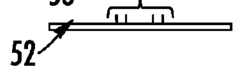

FIG. 7B

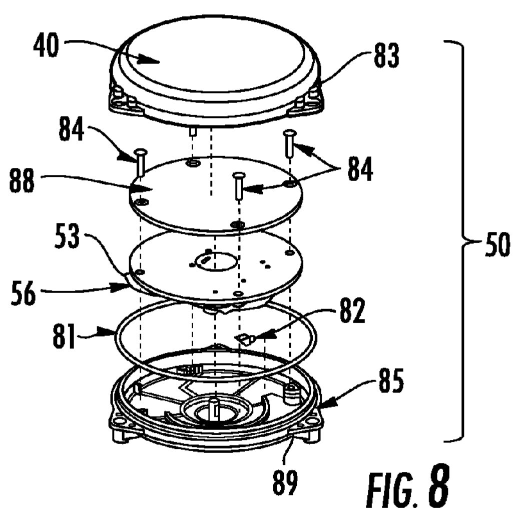

FIG. 8

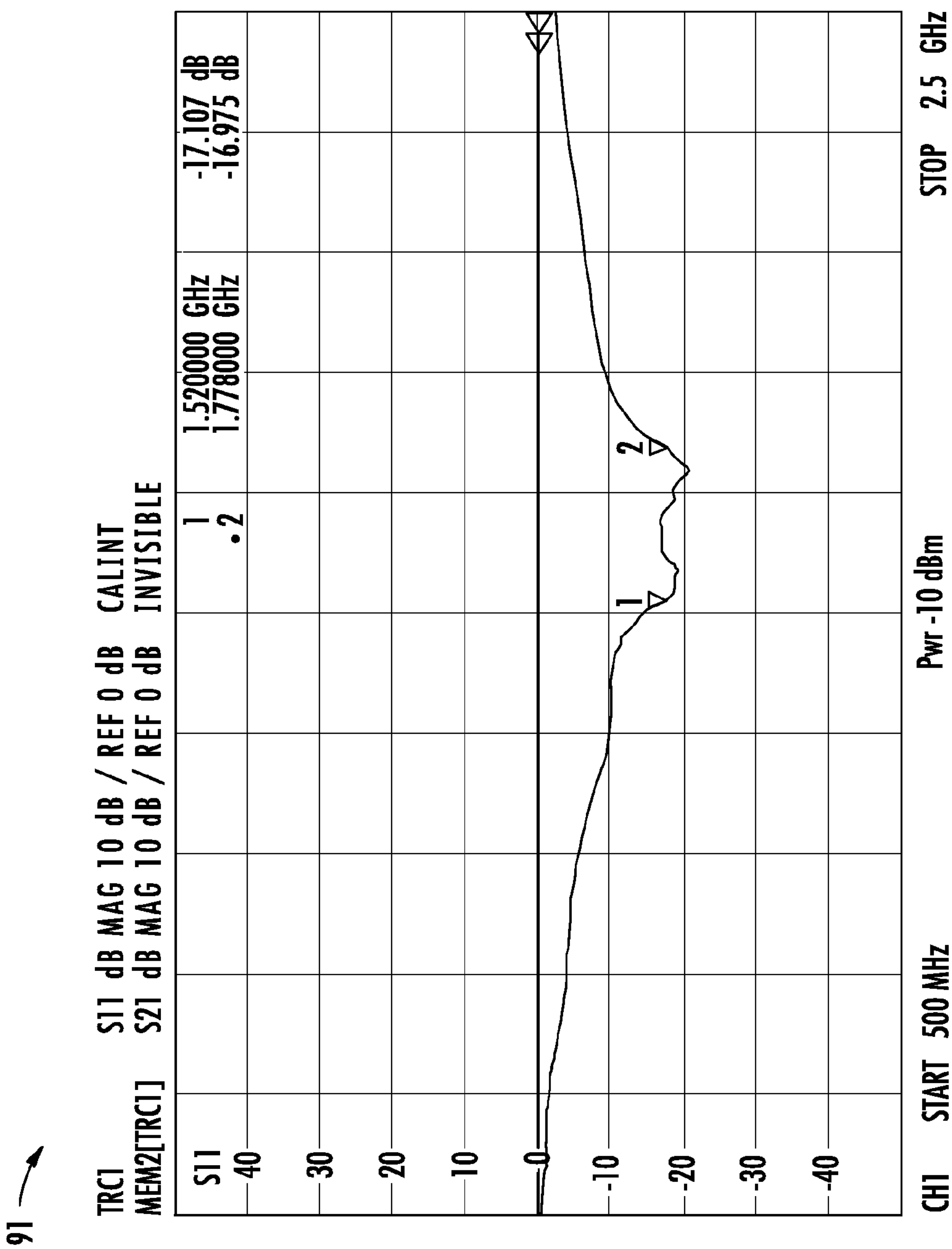
91
TRC1 S11 dB MAG 10 dB / REF 0 dB CALINT
MEM2[TRC1] S21 dB MAG 10 dB / REF 0 dB INVISIBLE
S11
1 1.520000 GHz -17.107 dB
•2 1.778000 GHz -16.975 dB
40
30
20
10
0
-10
-20
-30
-40
1
2
CH1 START 500 MHz Pwr -10 dBm STOP 2.5 GHz

FIG. 9A

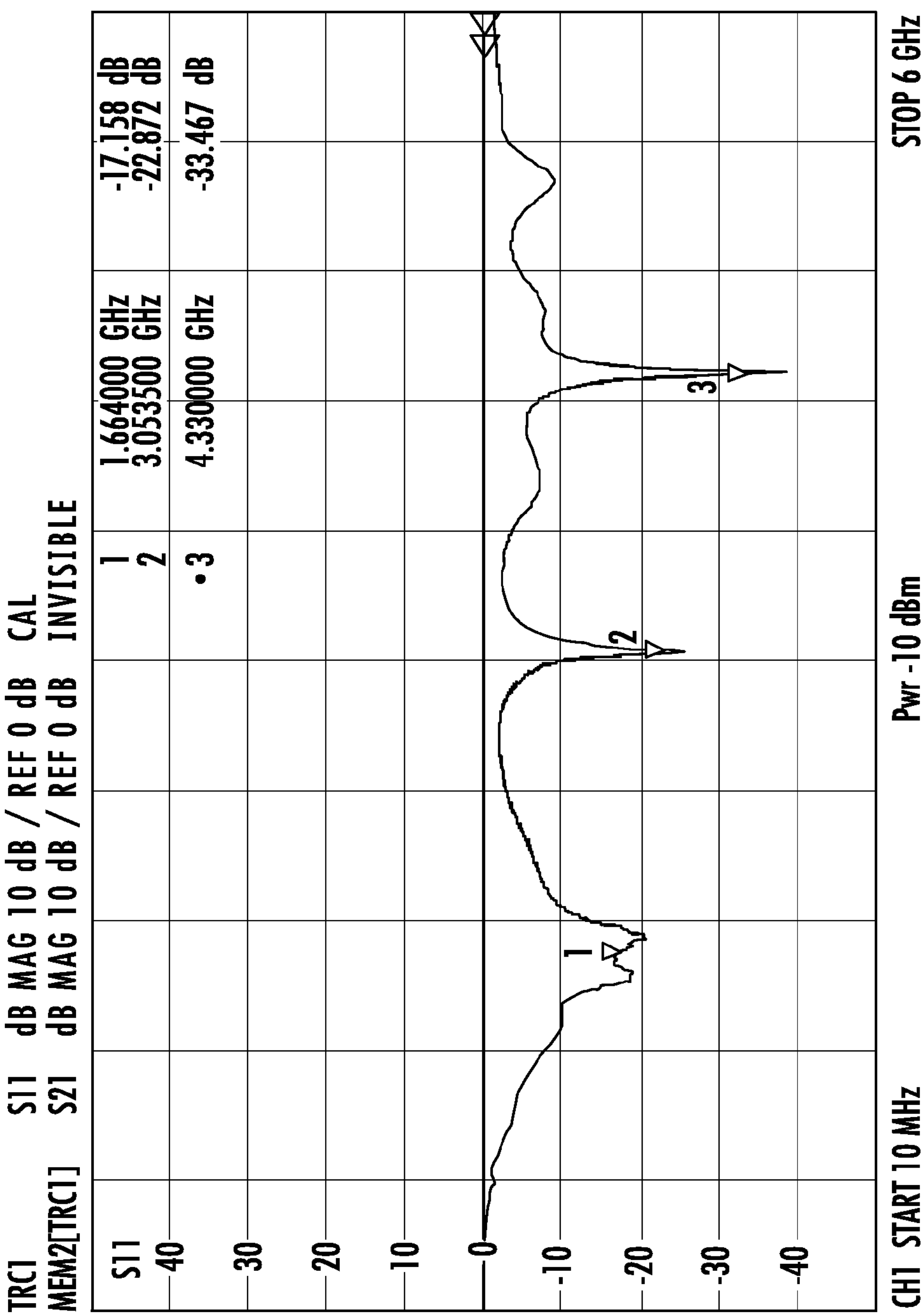
TRC1 S11 dB MAG 10 dB / REF 0 dB CAL
MEM2[TRC1] S21 dB MAG 10 dB / REF 0 dB INVISIBLE
1 1.664000 GHz -17.158 dB
2 3.053500 GHz -22.872 dB
•3 4.330000 GHz -33.467 dB
S11
40
30
20
10
0
-10
-20
-30
-40
1
2
3
CH1 START 10 MHz
Pwr -10 dBm
STOP 6 GHz

FIG. 9B

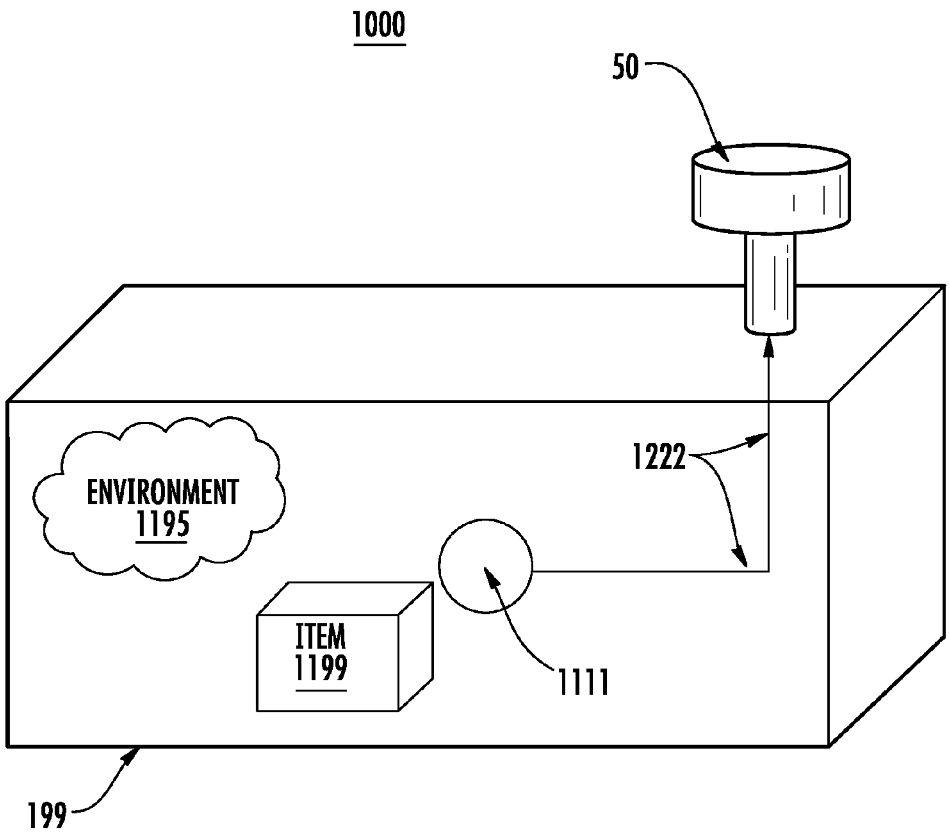

FIG. 10

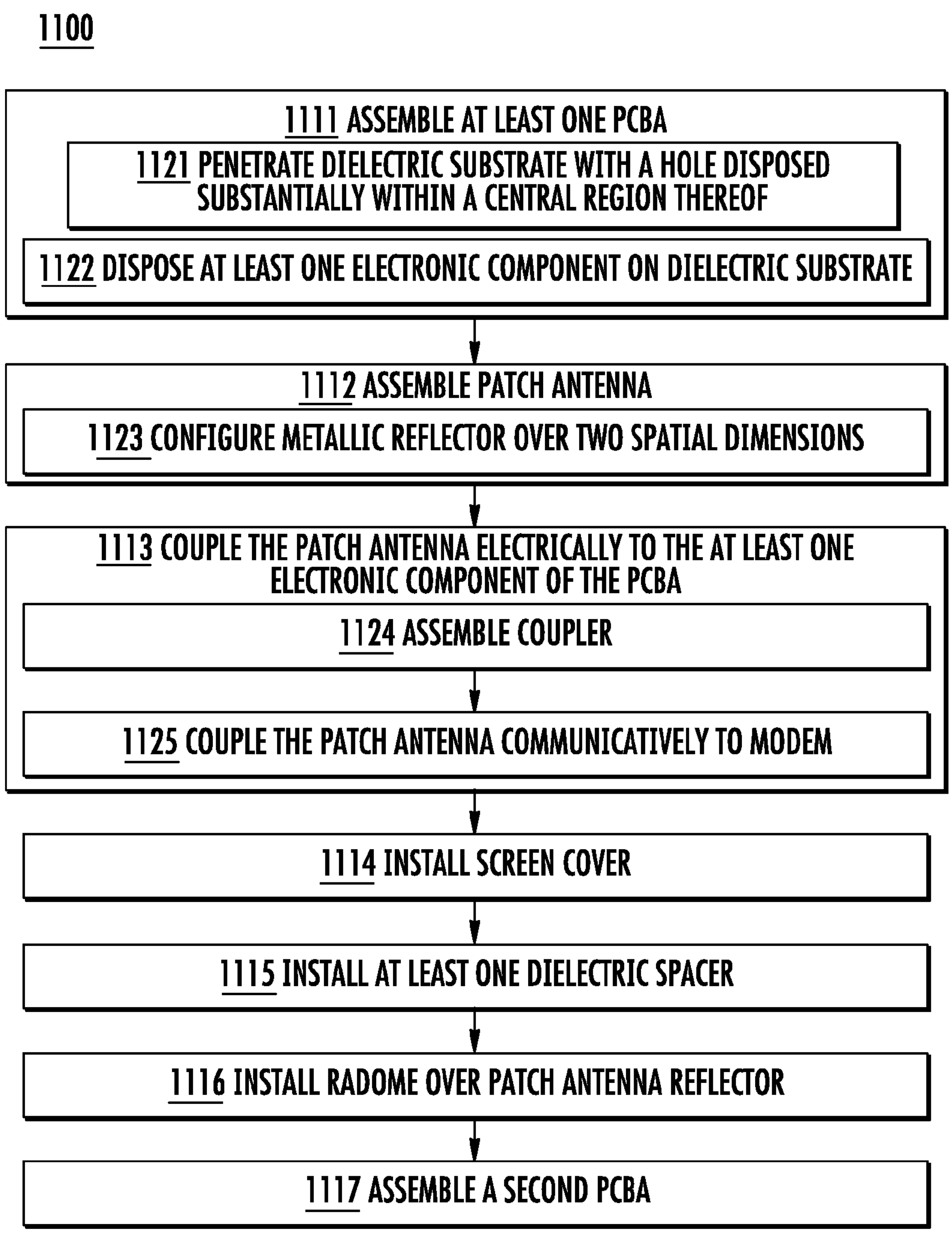
1100
1111 ASSEMBLE AT LEAST ONE PCBA
1121 PENETRATE DIELECTRIC SUBSTRATE WITH A HOLE DISPOSED SUBSTANTIALLY WITHIN A CENTRAL REGION THEREOF
1122 DISPOSE AT LEAST ONE ELECTRONIC COMPONENT ON DIELECTRIC SUBSTRATE
1112 ASSEMBLE PATCH ANTENNA
1123 CONFIGURE METALLIC REFLECTOR OVER TWO SPATIAL DIMENSIONS
1113 COUPLE THE PATCH ANTENNA ELECTRICALLY TO THE AT LEAST ONE ELECTRONIC COMPONENT OF THE PCBA
1124 ASSEMBLE COUPLER
1125 COUPLE THE PATCH ANTENNA COMMUNICATIVELY TO MODEM
1114 INSTALL SCREEN COVER
1115 INSTALL AT LEAST ONE DIELECTRIC SPACER
1116 INSTALL RADOME OVER PATCH ANTENNA REFLECTOR
1117 ASSEMBLE A SECOND PCBA

FIG. 11

PATCH ANTENNA

TECHNOLOGY FIELD

The present invention relates to communication. More particularly, an embodiment of the present invention relates to interfaces for coupling terrestrial transceivers communicatively to satellites.

BACKGROUND

Generally speaking, satellites are launched into earth orbit for various applications relating to terrestrial, nautical, aeronautical, civil, and commercial communication, navigation, exploration, and observation, scientific research, and others. The satellites transmit radio frequency (RF) signals related to their operations. The satellite RF signals may be collected, interpreted, and processed by terrestrial satellite transceivers (transmitter/receivers) operable for exchanging signals with the satellites or other entities.

Communications satellites are operable for relaying information from a transmission source to transceivers in telecommunication related applications. Global communication networks and services may be provided, sustained, and supported by a communication satellite constellation, which comprises a plurality of individual communication satellites. Communication networks are operable with the satellite constellations to provide global telephone and data services of various kinds to users of portable and/or mobile transceiver terminals.

The portable/mobile transceiver terminals comprise antenna components, with which they may connect and exchange signals with the satellites. One or more terrestrial ground stations may participate in the communications. The communications may relate to messages and other traffic with which assets may be tracked and monitored, which may be moved in commerce or other endeavors.

Satellite terminals installed on the tracked assets support the messaging, tracking, and monitoring. For example, the SAT-202™ satellite terminal Satellite terminal (commercially available from the Honeywell Global Tracking™ subsidiary of Honeywell International™, Inc., a corporation in New Jersey) comprises a multi-purpose satellite terminal that may be installed on tracked assets. The SAT-202™ terminals are operable for automatically selecting an available satellite within a satellite constellation, and regularly transmitting its location, telemetry data, and message data thereto over wireless data links.

Satellite transceivers comprise an antenna operable as an interface for exchanging RF signals with the communication satellites. The SAT-202™ transceiver terminals exchange signals with the satellites over the L-Band between one Gigahertz (1 GHz) and two (2) GHz (inclusive) of the RF spectrum. The transceiver may comprise a patch antenna, which may achieve circular polarization by quadrature excitation of two linearly polarized ports. For example, the SAT-202 satellite transceiver comprises an L-band patch antenna with circular polarization that provides significant gain over low elevation angles and a frequency range spanning 1525 Megahertz (MHz) to 1661 MHz, inclusive.

Typically, antennae used in the satellite transceivers are enclosed within a radome and comprise two or more printed circuit board assemblies (PCBAs). The radomes typically comprise a weather resistant plastic material, which is transparent over the antenna RF range. The PCBAs comprise one or more electronic components disposed over a printed circuit board (PCB), which comprises a dielectric

substrate and a network of conductive horizontal traces and/or vertical interconnect accesses ("vias"). The PCBAs, the PCB substrates thereof, and the attachment of the plastic radome during assembly of the antenna represent nontrivial expenses, which are typically reflected in the cost of the satellite transceivers.

For example, patch antennae in typical satellite transceivers may comprise internal coaxial cable couplers, as well as circuit components operable for the quadrature excitation of two linearly polarized ports to achieve circular polarization. In some transceivers, the polarizing circuit components may be disposed on a dedicated PCB, with associated cost and fabrication complexity issues. The quality of the circular polarization may be sensitive to the fabrication issues, and cross-polarization near the horizon may approach excessive levels. Left-hand polarization associated with this effect may cause signal fading at low elevation angles.

Therefore, a need exists for a satellite transceiver antenna that provides significant gain over a wide angle from an axis of maximum radiated power, and over a wide range of terrestrial locations world-wide for exchanging signals from geostationary communication satellites. A need also exists to implement the satellite transceiver antenna with right-hand circular polarization and to avoid interference associated with left-hand polarization. Further, a need exists to reduce complexity and costs related to components and fabrication of the satellite transceiver antenna, relative to existing conventional approaches.

SUMMARY

Accordingly, in one aspect, example embodiments of the present invention embrace a satellite transceiver antenna that provides significant gain over a wide angle from its boresight (axis of maximum radiated power), and globally over a wide range of terrestrial locations world-wide for exchanging signals from geostationary communication satellites. An example embodiment relates to implementing a satellite transceiver antenna with right-hand circular polarization, which avoids interference associated with left-hand polarization. Further, example embodiments of the present invention reduce complexity and costs related to components and fabrication of the satellite transceiver antenna, relative to existing conventional approaches.

A terrestrial transceiver is described, which is operable for exchanging RF signals with one or more communication satellites. The terrestrial transceiver comprises a patch antenna sensitive to signals within an L-Band RF range and operable for providing a gain to the RF signals. The patch antenna comprises a reflector. The reflector comprises a metallic material of a characteristic dimension and is operable for shaping a pattern of the RF gain of the patch antenna. Further, the transceiver comprises at least one printed circuit board assembly (PCBA).

The PCBA comprises a dielectric substrate, at least one electronic component disposed upon the dielectric substrate, and a hole penetrating the dielectric substrate and disposed substantially within a central region thereof. Based on the dimension characteristic of the reflector and on one or more of a positioning or a dimension of the hole, the RF gain diverges over an angle from a boresight of the patch antenna.

The terrestrial transceiver may also comprise a modulator/demodulator (modem) communicatively coupled to the patch antenna and operable for modulating and for demodulating the RF signals.

The terrestrial transceiver may also comprise a coupler assembly. The coupler assembly may comprise a pair of

pins, each comprising a conductive material. The pair of pins is operable for coupling signals within the RF range between the patch antenna and the at least one electronic component of the PCBA. The coupler assembly also comprises a screen cover comprising a conductive material and operable for providing a ground connection between the modem and a ground plane of the patch antenna. Further, the coupler assembly comprises at least one spacer, which comprises a dielectric material.

The at least one spacer may comprise an antenna spacer operable for providing an electrical insulation between the modem and the ground plane of the patch antenna. The at least one spacer may also (or alternatively) comprise a screen spacer operable for providing one or more of an electrical insulation, or a mechanical support for the screen cover.

The terrestrial transceiver may also comprise a radome. The radome comprises a material transparent to the RF radiation and is operable for protectively housing the patch antenna within an operating environment of the transceiver. The reflector is suspended within the radome.

The metallic material of the suspended reflector may comprise a stamped metal. The characteristic dimension of the suspended reflector may comprise a shape configured over two spatial dimensions. A frequency bandwidth characteristic of the patch antenna may relate to the configured shape of the suspended reflector.

The terrestrial transceiver may also comprise a component operable for providing a first linear excitation to a first port of a pair of ports, a second linear excitation to a second port of the pair of ports wherein the second linear excitation is provided in a quadrature relationship to the first port of the pair. A circular polarization pattern is imparted to the patch antenna by the quadrature pair of excitations. In an example embodiment, a left-handed polarization of the antenna is rejected over low elevation angles within the RF operating range of the antenna.

The component operable for providing a first linear excitation and the second linear excitation may comprises a splitter, such as a Wilkinson splitter. Further, the excitation component may relate to the at least one electronic component disposed upon the dielectric substrate of the at least one PCBA.

The terrestrial transceiver may also comprise at least a second PCBA. The at least second PCBA may comprise a PCBA operable for providing a ground plane for the patch antenna, which has a radiating element coupled to the patch antenna and operable for radiating the RF signals thereto. The at least second PCBA may also (or alternatively) comprise a substrate. The substrate comprises a dielectric material and is operable for insulating the patch antenna electrically.

In another aspect, an example embodiment of the present invention relates to a fabrication process. An example embodiment of the present invention relates to a method for fabricating a terrestrial satellite transceiver operable for exchanging RF signals with a satellite, such as the transceiver summarized above. In an example embodiment, the fabrication method comprises assembling at least one PCBA.

The assembly of the PCBA comprises penetrating a dielectric substrate with a hole disposed substantially within a central region thereof and disposing at least one electronic component on the dielectric substrate.

A patch antenna is attached to the PCBA. The patch antenna comprises a reflector and is sensitive to signals within an L-Band RF range and operable for providing a gain to the RF signal. The reflector may comprise a metallic material. A shape is configured for a metallic reflector over two spatial dimensions. A frequency bandwidth characteristic of the patch antenna relates to the configured shape of the reflector.

The metallic reflector is operable for shaping a pattern of the RF gain of the patch antenna. Based on the shape configured over the two dimensions of the reflector and on a positioning, and/or on a dimension of the hole disposed in the at least one PCBA, the RF gain diverges over an angle from a boresight of the patch antenna.

An example embodiment of the present invention relates to a terrestrial transceiver product, which is implemented by a process such as the fabrication process summarized above. The transceiver product may comprise or correspond to the terrestrial satellite transceiver, which is also summarized above.

In yet another aspect, an example embodiment of the present invention relates to a satellite communication network. In an example embodiment, the satellite communication network comprises a satellite constellation. The satellite constellation comprises a plurality of communication satellites.

Each of the communication satellites is deployed in a geosynchronous, geostationary earth orbit (GEO). The satellite communication network also comprises one or more terrestrial transceivers operable for exchanging RF signals with one or more of the plurality of communication satellites.

The one or more terrestrial transceivers comprise a patch antenna sensitive to signals within an L-Band RF range and operable for providing a gain to the RF signals. The patch antenna comprises a reflector. The reflector comprises a metallic material of a characteristic dimension and is operable for shaping a pattern of the RF gain of the patch antenna. Further, the one or more terrestrial transceivers comprise at least one PCBA.

The PCBA comprises a dielectric substrate, at least one electronic component disposed upon the dielectric substrate, and a hole penetrating the dielectric substrate and disposed substantially within a central region thereof wherein. The RF gain diverges over an angle from a boresight of the patch antenna based on the dimension characteristic of the reflector, and on a positioning and/or a dimension of the hole. The transceiver may comprise or correspond to the terrestrial satellite transceiver summarized above.

The foregoing summary is presented by way of example, and not limitation, as a conceptual prelude to the following detailed description of example embodiments and each figure (FIG.) of the accompanying drawing, referred to therein.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts a first view of example satellite communication network, according to an example embodiment of the present invention;

FIG. **2** depicts a second view of example satellite communication network, according to an example embodiment of the present invention;

FIG. **3** depicts an assembled view of an example patch antenna reflector mounted in a radome, according to an example embodiment of the present invention;

FIG. **4** depicts an exploded view of the example patch antenna reflector and the radome, according to an example embodiment of the present invention;

FIG. **5** depicts an exploded view of a portion of an example terrestrial transceiver, according to an example embodiment of the present invention;

FIG. **6**A depicts a top view of an example PCB, according to an example embodiment of the present invention;

FIG. **6**B depicts a lateral view of the example PCB, according to an example embodiment of the present invention;

FIG. **6**C depicts a view of the example PCB partly from a side and partly from the top, according to an example embodiment of the present invention;

FIG. **7**A depicts a top view of an example antenna spacer, according to an example embodiment of the present invention;

FIG. **7**B depicts a lateral view of the example antenna spacer, according to an example embodiment of the present invention;

FIG. **8** depicts an exploded view of an example terrestrial transceiver, according to an example embodiment of the present invention;

FIG. **9**A depicts a first example antenna power spectrum, according to an example embodiment of the present invention;

FIG. **9**B depicts a second example antenna power spectrum, according to an example embodiment of the present invention;

FIG. **10** depicts an example telemetry system, according to an example embodiment of the present invention; and

FIG. **11** depicts a flowchart for an example fabrication process, according to an example embodiment of the present invention.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS

Example embodiments of the present invention are described in relation to a terrestrial transceiver, which is operable for exchanging RF signals with one or more communication satellites. The terrestrial transceiver comprises a patch antenna sensitive to signals within an L-Band RF range and operable for providing a gain to the RF signals. The patch antenna comprises a reflector. The reflector comprises a metallic material of a characteristic dimension and is operable for shaping a pattern of the RF gain of the patch antenna. Further, the transceiver comprises at least one PCBA.

The satellite transceiver antenna described herein provides significant gain over a wide angle from its boresight, which comprises its axis of maximum radiated power, and globally over a wide range of terrestrial locations worldwide for exchanging signals from geostationary communication satellites. An example embodiment relates to implementing a satellite transceiver antenna with right-hand circular polarization, which avoids interference associated with left-hand polarization. Further, example embodiments of the present invention reduce complexity and costs related to components and fabrication of the satellite transceiver antenna, relative to existing conventional approaches.

Overview.

An example embodiment of the present invention relates to a terrestrial transceiver, which is operable for exchanging RF signals with one or more communication satellites. The terrestrial transceiver comprises a patch antenna sensitive to signals within an L-Band RF range and operable for providing a gain to the RF signals. The patch antenna comprises a reflector. The reflector comprises a metallic material of a characteristic dimension and is operable for shaping a pattern of the RF gain of the patch antenna. Further, the transceiver comprises at least one PCBA.

The PCBA comprises a dielectric substrate, at least one electronic component disposed upon the dielectric substrate, and a hole penetrating the dielectric substrate and disposed substantially within a central region thereof. Based on the dimension characteristic of the reflector and on one or more of a positioning or a dimension of the hole, the RF gain diverges over an angle from a boresight of the patch antenna.

The terrestrial transceiver may also comprise a modem communicatively coupled to the patch antenna and operable for modulating and for demodulating the RF signals.

The terrestrial transceiver may also comprise a coupler assembly. The coupler assembly may comprise a pair of pins, each comprising a conductive material. The pair of pins is operable for coupling signals within the RF range between the patch antenna and the at least one electronic component of the PCBA. The coupler assembly also comprises a screen cover comprising a conductive material and operable for providing a ground connection between the modem and a ground plane of the patch antenna. Further, the coupler assembly comprises at least one spacer, which comprises a dielectric material.

The at least one spacer may comprise an antenna spacer operable for providing an electrical insulation between the modem and the ground plane of the patch antenna. The at least one spacer may also (or alternatively) comprise a screen spacer operable for providing one or more of an electrical insulation, or a mechanical support for the screen cover.

The terrestrial transceiver may also comprise a radome. The radome comprises a material transparent to the RF radiation and is operable for protectively housing the patch antenna within an operating environment of the transceiver. The reflector is suspended within the radome.

The metallic material of the suspended reflector may comprise a stamped metal. The characteristic dimension of the suspended reflector may comprise a shape configured over two spatial dimensions. A frequency bandwidth characteristic of the patch antenna may relate to the configured shape of the suspended reflector.

The terrestrial transceiver may also comprise a component operable for providing a first linear excitation to a first port of a pair of ports, a second linear excitation to a second port of the pair of ports wherein the second linear excitation is provided in a quadrature relationship to the first port of the pair. A circular polarization pattern is imparted to the patch antenna by the quadrature pair of excitations. In an example embodiment, a left-handed polarization of the antenna is rejected over low elevation angles within the RF operating range of the antenna.

The component operable for providing a first linear excitation and the second linear excitation may comprises a splitter, such as a Wilkinson splitter. Further, the excitation component may relate to the at least one electronic component disposed upon the dielectric substrate of the at least one PCBA.

The terrestrial transceiver may also comprise at least a second PCBA. The at least second PCBA may comprise a PCBA operable for providing a ground plane for the patch antenna, which has a radiating element coupled to the patch antenna and operable for radiating the RF signals thereto. The at least second PCBA may also (or alternatively) comprise a substrate. The substrate comprises a dielectric material and is operable for insulating the patch antenna electrically.

Example Satellite Communication Network.

An example embodiment of the present invention relates to a satellite communication network. FIG. **1** depicts a first view of example satellite communication network **100**, according to an example embodiment of the present invention.

In an example embodiment, the communication network comprises a constellation (**125**; FIG. **2**) of communication satellites in a geosynchronous, geostationary earth orbit (GEO) **105**. The satellite constellation comprises a communication satellite **111**.

A tracked asset **199** comprises a terrestrial satellite transceiver **50**. The transceiver **50** is operable for exchanging RF signals **155** with the satellite **111** (and other satellites of the constellation). The transceiver **50** is operable as a transceiver and as a transmitter in relation to the exchange of the RF signals **155** with the satellite **111** and other satellites of the constellation. Thus, the transceiver **50** comprises transceiver related functionality, operability and capability.

The RF signals **155** may comprise communication signals relating to LDRS, data, messaging, telephony, telemetry, geopositioning, and navigation and others and may allow tracking and other reports relating to the tracked asset **199**. Using the LDRS, the satellite communication network **100** is operable for tracking, monitoring, messaging, and telemetry of vessels, vehicles, aircraft, cargoes, containers, personnel and various other items represented by the tracked asset **199**, which may be moved in relation to commerce or other endeavors. The transceiver **50** installed on the tracked asset **199** supports the messaging, tracking, monitoring, and telemetry features.

The tracked asset **199** represents a terrestrial item, which may comprise a cargo, cargo item, container, trailer, barge, structure, vehicle, and others. The vehicle may be operable over one or more transport medium (e.g., water, air, land, etc.). The tracked asset **199** may even represent a living thing such as a person, animal, or group. The tracked asset **199** is disposed or deployed over a terrestrial surface. The terrestrial surface may comprise land, water, a structure (such as a building), stack, or a deck, cargo bay, or other portion of a vehicle.

FIG. **2** depicts a second view of the example satellite communication network **100**, according to an example embodiment of the present invention. The satellite constellation **125** comprises a plurality of communication satellites **111** through **115**, inclusive.

Each communication satellite of the constellation **125** is deployed in substantially circular geosynchronous, geostationary earth orbit (GEO) **105**. Each of the satellites of the constellation **125** thus orbits earth in space at an altitude of approximately 22,236 statute miles (35,786 kilometers) above mean sea level, "eastward" over a substantially equatorial plane, and with a period of approximately 23 hours 56 minutes and 4 seconds and in synchronism with the earth sidereal rotational period.

An example embodiment may be implemented in which the constellation **125** represents the INMARSAT™ constellation of communication satellites, or a constellation with similar capabilities and characteristics. The INMARSAT™ constellation comprises at least five (5) telecommunication satellites **111**, **112**, **113**, **114**, and **115**. The satellites of the constellation **125** orbit the earth in a GEO (represented by the GEO **125**) and operated by INMARSAT™ (also known as the "International Maritime Satellite Organization," a public company doing business in Great Britain). The INMARSAT™ communications satellite constellation and networks provide global telephone and data services of various kinds to users of portable and/or mobile transceiver terminals.

The portable/mobile transceiver terminals comprise antenna components, with which they may connect to the satellites through one or more terrestrial ground stations. For example, a low data rate service (LDRS) is operable over the INMARSAT™ constellation and networks for tracking, monitoring, messaging, and telemetry of vessels, vehicles, aircraft, cargoes, containers, personnel and various assets (represented by the tracked assets **199**) that may be moved in relation to commerce or other endeavors.

The satellite communication network **100** also comprises one or more terrestrial transceivers, represented by the transceiver **50** and described in relation thereto. The transceiver **50** is operable for exchanging RF signals with one or more of the plurality of communication satellites.

In a first terrestrial location, the transceiver **50** exchanges the RF signals **155** with the satellite **111**. As the transceiver **50** moves over the terrestrial surface, it may exchange the RF signals **155** with one or more of the other satellites (e.g., **114**, etc.) of the constellation **125**. The transceiver **50** comprises a patch antenna **30**. The patch antenna **30** comprises a reflector **33**, which may be suspended in a radome **40**.

Example Terrestrial Satellite Transceiver.

FIG. **3** depicts an assembled view of an example reflector **33** mounted in a radome **40** of the patch antenna **30**, according to an example embodiment of the present invention. FIG. **4** depicts an exploded view of the example reflector **33** and the radome **40** of the patch antenna **30**, according to an example embodiment of the present invention.

The patch antenna **30** is sensitive to signals within an L-Band RF range and operable for providing a gain to the RF signals. The reflector **33** comprises a metallic material of a characteristic dimension and is operable for shaping a pattern of the RF gain of the patch antenna **30**. The reflector **33** is operable for shaping a pattern of the RF gain of the patch antenna. Further, the transceiver comprises at least one PCBA.

FIG. **5** depicts an exploded view of a portion of the example terrestrial transceiver **50**, according to an example embodiment of the present invention. An 'H**1**' PCB **52** is operable for providing a ground plane **521** for the antenna **30**. The ground plane is disposed over a surface of a dielectric substrate **521**. A radiating element ("Rad.") **555** is disposed on the 'H**1**' PCB of the patch antenna **50**.

FIG. **6**A depicts a top view of an example 'H**1**' PCB **52**, according to an example embodiment of the present invention. FIG. **6**B depicts a lateral view of the example 'H**1**' PCB **52**, according to an example embodiment of the present invention. FIG. **6**C depicts a view of the example PCB partly from a side and partly from the top, according to an example embodiment of the present invention.

The 'H**1**' PCBA **52** comprises a dielectric substrate **521** and at least one electronic component, such as the radiating element **555** disposed upon the dielectric substrate **521**. The substrate **521** is penetrated by a hole **66**. The hole **66** penetrates a central region of the dielectric substrate **521** in which it is substantially disposed. Based on the configured dimension characteristic of the reflector **33**, and on a positioning and/or a dimension of the hole **66**, the RF gain diverges over an angle from a boresight of the patch antenna **30**. The transceiver **50** may also comprise an antenna spacer **53**.

FIG. **7**A depicts a top view of the example antenna spacer **53**, according to an example embodiment of the present invention. The modem PCBA **56** and/or the modem **555** may be electrically and mechanically coupled to a component of the antenna spacer **53**. FIG. **7**B depicts a lateral view of the example antenna spacer **53**, according to an example embodiment of the present invention. The antenna spacer **53** is operable for providing electrical insulation between the modem **550** and a ground plane **533** of the patch antenna **30**.

The modem comprises one or more electronic components **550** disposed on a modem PCBA **56**, which may be disposed within a housing or cover **59**.

FIG. **8** depicts an exploded view of the example terrestrial transceiver **50**, according to an example embodiment of the present invention.

In FIG. **6**B and FIG. **6**C and FIG. **8**, the modem PCBA **56** is shown disposed over one (e.g., lower) surface of the 'H**1**' PCBA **52**. The modem **56** is operable for modulating signals to the antenna **30**, which may be radiated by the radiating element **555** and the reflector **33**. The modem is also operable for demodulating signals received by the antenna from the satellites of the constellation **125**.

The terrestrial transceiver **50** may also comprise a coupler assembly **557**. The coupler assembly **557** comprises a pair of pins **51**, each comprising a conductive material. The pair of pins **51** is operable for coupling signals within the RF range between the patch antenna **30** and the radiating element **555** of the 'H**1**' PCBA **52**.

The coupler assembly also comprises a screen cover **54**. The screen cover **54** comprises a conductive material and is operable for providing a ground connection between the modem **550** and a ground plane **533** of the patch antenna **30**. Further, the coupler assembly comprises a screen spacer **55**, which comprises a dielectric material. The screen spacer **55** is operable for providing electrical insulation and mechanical support for the screen cover **54**.

The radiating element **555** comprises a component operable for providing a first linear excitation to a first port of a pair of ports, a second linear excitation to a second port of the pair of ports wherein the second linear excitation is provided in a quadrature relationship to the first port of the pair.

A circular polarization pattern is imparted to the patch antenna **30** by the quadrature pair of excitations. In an example embodiment, a left-handed polarization of the antenna is rejected over low elevation angles within the RF operating range of the antenna. An example embodiment may be implemented in which the radiating element **555** comprises a power divider such as a Wilkinson splitter.

Power coupling characteristics of the example transceiver **30** may be represented in power spectra corresponding to various frequency ranges. The power spectra may be computed, predicted, modeled, measured, and/or monitored in relation to an implementation of the example transceiver **30**.

FIG. **9**A depicts a first example antenna power spectrum **91**, according to an example embodiment of the present invention. The power spectrum **91** represents the power coupled by the antenna **30** over a frequency range extending from 500 MHz to 2.5 GHz, inclusive.

FIG. **9**B depicts a second example antenna power spectrum, according to an example embodiment of the present invention. The power spectrum **91** represents the power coupled by the antenna **30** over a frequency range extending from 10 MHz to 6 GHz, inclusive.

FIG. **10** depicts an example telemetry system **1000**, according to an example embodiment of the present invention. The telemetry system may comprise the terrestrial transceiver **50** and a sensor **1111**. The sensor **1111** may be disposed in proximity to the tracked asset **199**. The sensor **1111** may also (or alternatively) be disposed within (and/or upon an internal or external surface of) the tracked asset **199**.

The sensor **1111** may comprise an array of multiple sensor components. The sensor **1111** is coupled communicatively with the transceiver **50** by a signal conductor or other wireline or wireless data link **1222**. The sensor component **1111** is operable for sensing, detecting, and/or measuring one or more characteristics or parameters relating to an (e.g., internal) environment **1195** of the tracked asset **199** and/or a cargo or component item **1199** therein. The characteristics and/or parameters may relate to temperature, humidity, pressure, vibration, shock, atmospheric environmental chemistry and physics, and/or others.

The transceiver **50** may be operable for providing multipurpose tracking and monitoring high-value tracked assets represented by the example item **199**. The transceiver **50** is operable for selecting a best, or most appropriate one of the satellites **111** through **115**, inclusive, of the constellation **125**. The transceiver **50** may then regularly transmit its location (and thus that of the tracked asset **199**) and any additional message data, which may comprise data related to outputs signals of the sensors **1111**. The transceiver **50** may be implemented for use in various, e.g., external environments and may thus be deployed and used world-wide in any season.

Example Fabrication Process.

An example embodiment of the present invention also relates to a method for fabricating a terrestrial satellite transceiver operable for exchanging RF signals with a satellite. FIG. **11** depicts a flowchart for an example fabrication process, according to an embodiment of the present invention.

In step **1111**, at least one PCBA is assembled. The PCBA may comprise a dielectric substrate. The assembly of the at least one PCBA may comprise a step **1121** and a step **1122**.

In the step **1121**, the dielectric substrate is penetrated with a hole. The hole is disposed substantially within a central region of the PCBA. In step the **1122**, at least one electronic component is disposed on the dielectric substrate.

In step **1112**, a patch antenna is assembled. The patch antenna is sensitive to signals within an L-Band RF range and operable for providing a gain to the RF signal. The patch antenna may comprise a metallic reflector and the assembly of the patch antenna may comprise a step **1123**.

In the step **1123**, a shape is configured for a metallic reflector over two spatial dimensions. A frequency bandwidth characteristic of the patch antenna relates to the configured shape of the reflector. The metallic reflector is operable for shaping a pattern of the RF gain of the patch antenna. Based on the shape configured over the two dimensions of the reflector and on a positioning, and/or on a dimension of the hole disposed in the at least one PCBA, the RF gain diverges over an angle from a boresight of the patch antenna.

In step **1113**, the patch antenna is coupled electrically to the at least one electronic component of the PCBA. The at least one electronic component of the PCBA may comprise a modem, and the step **1113** may comprise a step **1124** and a step **1125**.

In the step **1124**, a coupler is assembled. In the step **1125**, the patch antenna is coupled communicatively via the assembled coupler to the modem. The modem is operable for modulating and for demodulating the RF signals. The coupling the patch antenna and the at least one electronic component of the PCBA communicatively in relation to conducting signals within the RF range between the patch antenna and the at least one electronic component of the PCBA.

In step **1114**, a screen cover may be installed. The screen cover comprises a conductive material and is operable for providing a ground connection between the modem and a ground plane of the patch antenna.

In step **1115**, at least one spacer comprising a dielectric material may be installed. The at least one dielectric spacer may comprise an antenna spacer operable for providing an electrical insulation between the modem and the ground plane of the patch antenna. The at least one spacer may also (or alternatively) comprise a screen spacer operable for providing an electrical insulation and/or a mechanical support for the screen cover.

In step **1116**, a radome may be installed over the patch antenna, e.g., over the metallic reflector thereof. In an example embodiment, the radome may be installed over the antenna reflector using a technique related to heat staking. The radome comprises a material such as a plastic, which is transparent to the RF radiation and operable for protectively housing the patch antenna within an operating environment of the transceiver. The reflector is suspended within the radome.

In step **1115**, at least one spacer comprising a dielectric material may be installed. The at least one dielectric spacer may comprise an antenna spacer operable for providing an electrical insulation between the modem and the ground plane of the patch antenna. The at least one spacer may also (or alternatively) comprise a screen spacer operable for providing an electrical insulation and/or a mechanical support for the screen cover.

In step **1116**, a radome may be installed over the patch antenna, e.g., over the metallic reflector thereof. In an example embodiment, the radome may be installed over the antenna reflector using a technique related to heat staking. The radome comprises a material such as a plastic, which is transparent to the RF radiation and operable for protectively housing the patch antenna within an operating environment of the transceiver. The reflector is suspended within the radome.

In a step **1117**, a second PCBA may be assembled. The second PCBA operable for providing a ground plane for the patch antenna and comprising a radiating element coupled to the patch antenna and operable for radiating the RF signals thereto. The second PCBA may comprise a dielectric substrate and is operable for insulating the patch antenna electrically.

An example embodiment of the present invention relates to a terrestrial transceiver product, which is implemented by a process such as the fabrication process **1100**. The fabrication process **1100** is described by way of illustration and is not intended to reflect any limitation or restriction to implementing example embodiments of the present invention. On the contrary, example embodiments of the present invention are well suited to implementation using an alternative (or additional) method, which is reflected by the fabrication process **1100**.

Example embodiments may be implemented in which the steps **1111** through **1117** (inclusive) and/or the steps **1121** through **1125** (inclusive) are performed without respect to any particular order or sequence. An example embodiment may also (or alternatively) be implemented in which one or more of the steps **1111** through **1117** (inclusive) and/or the steps **1121** through **1125** (inclusive) are optional or omitted, and/or with one or more additional (or alternative) steps.

Use of the suspended reflector **33** simplifies and reduces costs related to fabrication of antenna products, and transceiver products comprising the antenna product relative to conventional antennas and transceivers, which use an additional PCB instead. Shaping of the reflector **33** provides sufficient frequency bandwidth. The shaping of the reflector **33** allows efficient and economical compatibility with material tolerances related to the 'H**1**' PCBA **52**, which may also allow economical implementation of the substrate **521**. The suspension of the reflector **33** within the radome **40** allows also the simplification of assembly related to its incorporation it in the radome **40**, and its attachment, which may relate to use of economical heat staking techniques.

In an example embodiment, the hole **66** penetrating the 'H**1**' PCBA **52** (and the configured shape of the reflector **33**) provide gain over a wide angle from boresight of the antenna **30**. Thus, the transceiver **50** is operable for providing transceiver functionality for geostationary satellite communications from all locations on earth. An example embodiment is implemented in which the hole **66** penetrating the middle of the substrate **521** of the 'H**1**' PCBA **52**, and fine-tuning the dimensions of the patch antenna **30** and the reflector element **33**. Example embodiments are implemented which substantially reject left-hand polarization for low elevation angles in operating bands of the transceiver **50**, and thus ameliorates signal interference due to fading introduced by signals reflecting on the ground.

In an example embodiment, use of the Wilkinson splitter, e.g., as a power divider and/or as a component of the radiating element **555**, economically provides the dual RF feed with a 90 degree phase shift on the 'H**1**' PCBA **52**, which obviates at least one additional PCB and related complexity and cost relative to typical transceivers. Further, use of the pins **51**, screen cover **54**, and antenna spacer **53** to configure the coupler **557** for coupling the antenna **30** to the electronic component(s) of the 'H**1**' PCBA **52** obviates use of coaxial cable and related additional cost, impedance, and/or signal related rise time, which could restrict bandwidth.

To supplement the present disclosure, this application incorporates entirely by reference the following commonly assigned patents, patent application publications, and patent applications:

U.S. Pat. No. 6,832,725; U.S. Pat. No. 7,128,266;
U.S. Pat. No. 7,159,783; U.S. Pat. No. 7,413,127;
U.S. Pat. No. 7,726,575; U.S. Pat. No. 8,294,969;
U.S. Pat. No. 8,317,105; U.S. Pat. No. 8,322,622;
U.S. Pat. No. 8,366,005; U.S. Pat. No. 8,371,507;
U.S. Pat. No. 8,376,233; U.S. Pat. No. 8,381,979;
U.S. Pat. No. 8,390,909; U.S. Pat. No. 8,408,464;
U.S. Pat. No. 8,408,468; U.S. Pat. No. 8,408,469;
U.S. Pat. No. 8,424,768; U.S. Pat. No. 8,448,863;
U.S. Pat. No. 8,457,013; U.S. Pat. No. 8,459,557;
U.S. Pat. No. 8,469,272; U.S. Pat. No. 8,474,712;
U.S. Pat. No. 8,479,992; U.S. Pat. No. 8,490,877;
U.S. Pat. No. 8,517,271; U.S. Pat. No. 8,523,076;
U.S. Pat. No. 8,528,818; U.S. Pat. No. 8,544,737;
U.S. Pat. No. 8,548,242; U.S. Pat. No. 8,548,420;
U.S. Pat. No. 8,550,335; U.S. Pat. No. 8,550,354;
U.S. Pat. No. 8,550,357; U.S. Pat. No. 8,556,174;
U.S. Pat. No. 8,556,176; U.S. Pat. No. 8,556,177;
U.S. Pat. No. 8,559,767; U.S. Pat. No. 8,599,957;
U.S. Pat. No. 8,561,895; U.S. Pat. No. 8,561,903;
U.S. Pat. No. 8,561,905; U.S. Pat. No. 8,565,107;
U.S. Pat. No. 8,571,307; U.S. Pat. No. 8,579,200;
U.S. Pat. No. 8,583,924; U.S. Pat. No. 8,584,945;
U.S. Pat. No. 8,587,595; U.S. Pat. No. 8,587,697;
U.S. Pat. No. 8,588,869; U.S. Pat. No. 8,590,789;
U.S. Pat. No. 8,596,539; U.S. Pat. No. 8,596,542;
U.S. Pat. No. 8,596,543; U.S. Pat. No. 8,599,271;
U.S. Pat. No. 8,599,957; U.S. Pat. No. 8,600,158;

U.S. Pat. No. 8,600,167; U.S. Pat. No. 8,602,309;
U.S. Pat. No. 8,608,053; U.S. Pat. No. 8,608,071;
U.S. Pat. No. 8,611,309; U.S. Pat. No. 8,615,487;
U.S. Pat. No. 8,616,454; U.S. Pat. No. 8,621,123;
U.S. Pat. No. 8,622,303; U.S. Pat. No. 8,628,013;
U.S. Pat. No. 8,628,015; U.S. Pat. No. 8,628,016;
U.S. Pat. No. 8,629,926; U.S. Pat. No. 8,630,491;
U.S. Pat. No. 8,635,309; U.S. Pat. No. 8,636,200;
U.S. Pat. No. 8,636,212; U.S. Pat. No. 8,636,215;
U.S. Pat. No. 8,636,224; U.S. Pat. No. 8,638,806;
U.S. Pat. No. 8,640,958; U.S. Pat. No. 8,640,960;
U.S. Pat. No. 8,643,717; U.S. Pat. No. 8,646,692;
U.S. Pat. No. 8,646,694; U.S. Pat. No. 8,657,200;
U.S. Pat. No. 8,659,397; U.S. Pat. No. 8,668,149;
U.S. Pat. No. 8,678,285; U.S. Pat. No. 8,678,286;
U.S. Pat. No. 8,682,077; U.S. Pat. No. 8,687,282;
U.S. Pat. No. 8,692,927; U.S. Pat. No. 8,695,880;
U.S. Pat. No. 8,698,949; U.S. Pat. No. 8,717,494;
U.S. Pat. No. 8,717,494; U.S. Pat. No. 8,720,783;
U.S. Pat. No. 8,723,804; U.S. Pat. No. 8,723,904;
U.S. Pat. No. 8,727,223; U.S. Pat. No. D702,237;
U.S. Pat. No. 8,740,082; U.S. Pat. No. 8,740,085;
U.S. Pat. No. 8,746,563; U.S. Pat. No. 8,750,445;
U.S. Pat. No. 8,752,766; U.S. Pat. No. 8,756,059;
U.S. Pat. No. 8,757,495; U.S. Pat. No. 8,760,563;
U.S. Pat. No. 8,763,909; U.S. Pat. No. 8,777,108;
U.S. Pat. No. 8,777,109; U.S. Pat. No. 8,779,898;
U.S. Pat. No. 8,781,520; U.S. Pat. No. 8,783,573;
U.S. Pat. No. 8,789,757; U.S. Pat. No. 8,789,758;
U.S. Pat. No. 8,789,759; U.S. Pat. No. 8,794,520;
U.S. Pat. No. 8,794,522; U.S. Pat. No. 8,794,525;
U.S. Pat. No. 8,794,526; U.S. Pat. No. 8,798,367;
U.S. Pat. No. 8,807,431; U.S. Pat. No. 8,807,432;
U.S. Pat. No. 8,820,630; U.S. Pat. No. 8,822,848;
U.S. Pat. No. 8,824,692; U.S. Pat. No. 8,824,696;
U.S. Pat. No. 8,842,849; U.S. Pat. No. 8,844,822;
U.S. Pat. No. 8,844,823; U.S. Pat. No. 8,849,019;
U.S. Pat. No. 8,851,383; U.S. Pat. No. 8,854,633;
U.S. Pat. No. 8,866,963; U.S. Pat. No. 8,868,421;
U.S. Pat. No. 8,868,519; U.S. Pat. No. 8,868,802;
U.S. Pat. No. 8,868,803; U.S. Pat. No. 8,870,074;
U.S. Pat. No. 8,879,639; U.S. Pat. No. 8,880,426;
U.S. Pat. No. 8,881,983; U.S. Pat. No. 8,881,987;
U.S. Pat. No. 8,903,172; U.S. Pat. No. 8,908,995;
U.S. Pat. No. 8,910,870; U.S. Pat. No. 8,910,875;
U.S. Pat. No. 8,914,290; U.S. Pat. No. 8,914,788;
U.S. Pat. No. 8,915,439; U.S. Pat. No. 8,915,444;
U.S. Pat. No. 8,916,789; U.S. Pat. No. 8,918,250;
U.S. Pat. No. 8,918,564; U.S. Pat. No. 8,925,818;
U.S. Pat. No. 8,939,374; U.S. Pat. No. 8,942,480;
U.S. Pat. No. 8,944,313; U.S. Pat. No. 8,944,327;
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U.S. patent application Ser. No. 29/529,441 for INDICIA READING DEVICE filed Jun. 8, 2015 (Zhou et al.);

U.S. patent application Ser. No. 14/735,717 for INDICIA-READING SYSTEMS HAVING AN INTERFACE WITH A USER'S NERVOUS SYSTEM filed Jun. 10, 2015 (Todeschini);

U.S. patent application Ser. No. 14/738,038 for METHOD OF AND SYSTEM FOR DETECTING OBJECT WEIGHING INTERFERENCES filed Jun. 12, 2015 (Amundsen et al.);

U.S. patent application Ser. No. 14/740,320 for TACTILE SWITCH FOR A MOBILE ELECTRONIC DEVICE filed Jun. 16, 2015 (Bandringa);

U.S. patent application Ser. No. 14/740,373 for CALIBRATING A VOLUME DIMENSIONER filed Jun. 16, 2015 (Ackley et al.);

U.S. patent application Ser. No. 14/742,818 for INDICIA READING SYSTEM EMPLOYING DIGITAL GAIN CONTROL filed Jun. 18, 2015 (Xian et al.);

U.S. patent application Ser. No. 14/743,257 for WIRELESS MESH POINT PORTABLE DATA TERMINAL filed Jun. 18, 2015 (Wang et al.);

U.S. patent application Ser. No. 29/530,600 for CYCLONE filed Jun. 18, 2015 (Vargo et al);

U.S. patent application Ser. No. 14/744,633 for IMAGING APPARATUS COMPRISING IMAGE SENSOR ARRAY HAVING SHARED GLOBAL SHUTTER CIRCUITRY filed Jun. 19, 2015 (Wang);

U.S. patent application Ser. No. 14/744,836 for CLOUD-BASED SYSTEM FOR READING OF DECODABLE INDICIA filed Jun. 19, 2015 (Todeschini et al.);

U.S. patent application Ser. No. 14/745,006 for SELECTIVE OUTPUT OF DECODED MESSAGE DATA filed Jun. 19, 2015 (Todeschini et al.);

U.S. patent application Ser. No. 14/747,197 for OPTICAL PATTERN PROJECTOR filed Jun. 23, 2015 (Thuries et al.);

U.S. patent application Ser. No. 14/747,490 for DUAL-PROJECTOR THREE-DIMENSIONAL SCANNER filed Jun. 23, 2015 (Jovanovski et al.); and

U.S. patent application Ser. No. 14/748,446 for CORDLESS INDICIA READER WITH A MULTIFUNCTION COIL FOR WIRELESS CHARGING AND EAS DEACTIVATION, filed Jun. 24, 2015 (Xie et al.).

Example embodiments of the present invention thus relate to a satellite transceiver antenna **30** that provides significant gain over a wide angle from its boresight (axis of maximum radiated power), and globally over a wide range of terrestrial locations world-wide for exchanging signals from geostationary communication satellites. An example embodiment relates to implementing a satellite transceiver **50** antenna **30** with right-hand circular polarization, which avoids interference associated with left-hand polarization. Further, example embodiments of the present invention reduce complexity and costs related to components and fabrication of the satellite transceiver antenna, relative to existing conventional approaches.

An example embodiment of the present invention is thus described in relation to a terrestrial transceiver **50**, which is operable for exchanging RF signals with one or more communication satellites (e.g., of the constellation **125**). The terrestrial transceiver **50** comprises a patch antenna **30** sensitive to signals within an L-Band RF range and operable for providing a gain to the RF signals. The patch antenna **30** comprises a reflector **33**. The reflector **33** comprises a metallic material of a characteristic dimension and is operable for shaping a pattern of the RF gain of the patch antenna **30**. Further, the transceiver comprises at least one PCBA (e.g., 'H**1**' PCBA **52**).

Example embodiments of the present invention also relate to methods (e.g., process **1100**) for fabricating terrestrial transceivers, which are operable for exchanging RF signals with one or more communication satellites, a transceiver product (e.g., transceiver **50**) fabricated by the example process, and a satellite communication network comprising the example transceiver.

For clarity and brevity, as well as to avoid unnecessary or unhelpful obfuscating, obscuring, obstructing, or occluding features of an example embodiment, certain intricacies and details, which are known generally to artisans of ordinary skill in related technologies, may have been omitted or discussed in less than exhaustive detail. Any such omissions or discussions are unnecessary for describing example embodiments of the invention, and not particularly relevant to understanding of significant features, functions and aspects of the example embodiments described herein.

In the specification and/or figures, typical embodiments of the invention have been disclosed. The present invention is not limited to such example embodiments. The use of the term "and/or" includes any and all combinations of one or more of the associated listed items. The figures are schematic representations and so are not necessarily drawn to scale. Unless otherwise noted, specific terms have been used in a generic and descriptive sense and not for purposes of limitation.

What is claimed is:

1. A transceiver, the transceiver comprising:

a patch antenna sensitive to signals within an L-Band RF range, the antenna comprising a metallic reflector;

at least one printed circuit board assembly (PCBA) comprising a dielectric substrate, at least one electronic component disposed upon the dielectric substrate, and a hole penetrating the dielectric substrate;

a modulator/demodulator (modem) communicatively coupled to the patch antenna and operable for modulating and for demodulating RF signals; and

a coupler assembly, wherein the coupler assembly comprises:

a pair of pins, each comprising a conductive material, wherein the pair of pins is operable for coupling signals within an RF range between the patch antenna and the at least one electronic component of the at least one PCBA;

a screen cover comprising a conductive material and operable for providing a ground connection between the modem and a ground plane of the patch antenna; and

at least one spacer comprising a dielectric material.

2. The transceiver as described in claim **1** wherein the at least one spacer comprises one or more of:

an antenna spacer operable for providing an electrical insulation between the modem and the ground plane of the patch antenna; or

a screen spacer operable for providing one or more of an electrical insulation, or a mechanical support for the screen cover.

3. The transceiver as described in claim **1**, further comprising a radome, the radome comprising a material transparent to RF radiation and operable for protectively housing the patch antenna within an operating environment of the transceiver, wherein the reflector is suspended within the radome.

4. The transceiver as described in claim **3** wherein the metallic material of the suspended reflector comprises a stamped metal.

5. The transceiver as described in claim **3** wherein the characteristic dimension of the suspended reflector comprises a shape configured over two spatial dimensions and wherein a frequency bandwidth characteristic of the patch antenna relates to the configured shape of the suspended reflector.

6. The transceiver as described in claim **1**, further comprising a component operable for providing a first linear excitation to a first port of a pair of ports, a second linear excitation to a second port of the pair of ports wherein the second linear excitation is provided in a quadrature relationship to the first port of the pair, wherein a circular polarization pattern is imparted to the antenna.

7. The transceiver as described in claim **6** wherein a left-handed polarization of the antenna is rejected over low elevation angles within the RF operating range of the antenna.

8. The transceiver as described in claim **6** wherein the component operable for providing a first linear excitation and the second linear excitation comprises a splitter.

9. The transceiver as described in claim **8** wherein the splitter comprises a Wilkinson splitter.

10. The transceiver as described in claim **6** wherein the at least one electronic component disposed upon the dielectric substrate of the at least one PCBA comprises the component operable for providing the first linear excitation and the second linear excitation.

11. The transceiver as described in claim **1**, further comprising at least a second PCBA.

12. The transceiver as described in claim **11** wherein the at least second PCBA comprises one or more of:

a PCB operable for providing a ground plane for the patch antenna and comprising a radiating element coupled to the patch antenna and operable for radiating RF signals thereto; or

a PCB comprising a substrate, the substrate comprising a dielectric material and operable for insulating the patch antenna electrically.

13. A method for fabricating a terrestrial satellite transceiver, the method comprising the steps of:

assembling at least one printed circuit board assembly (PCBA), the assembly of the PCBA comprising penetrating a dielectric substrate with a hole and disposing at least one electronic component on the dielectric substrate;

configuring a shape of a metallic reflector over two spatial dimensions;

attaching a patch antenna comprising the configured metallic reflector to the at least one PCBA, the patch antenna sensitive to signals within an L-Band RF range;

coupling a modulator/demodulator (modem) communicatively to the patch antenna, the modem operable for modulating and for demodulating RF signals;

assembling a coupler assembly, wherein the assembly of the coupler assembly comprises the steps of:

coupling the patch antenna and the at least one electronic component of the PCBA communicatively in relation to conducting signals within an RF range between the patch antenna and the at least one electronic component of the PCBA;

installing a screen cover comprising a conductive material and operable for providing a ground connection between the modem and a ground plane of the patch antenna; and

installing at least one spacer comprising a dielectric material wherein the at least one spacer comprises one or more of:

an antenna spacer operable for providing an electrical insulation between the modem and the ground plane of the patch antenna; or

a screen spacer operable for providing one or more of an electrical insulation, or a mechanical support for the screen cover.

14. The fabrication method as described in claim **13**, further comprising installing a radome over the patch antenna using a heat staking related process step, the radome comprising a material transparent to RF radiation and operable for protectively housing the patch antenna within an operating environment of the transceiver, wherein the reflector is suspended within the radome.

15. The fabrication method as described in claim **13**, further comprising one or more of:

assembling a PCBA operable for providing a ground plane for the patch antenna and comprising a radiating element coupled to the patch antenna and operable for radiating RF signals thereto; or

assembling a PCB comprising a substrate, the substrate comprising a dielectric material and operable for insulating the patch antenna electrically.

16. A satellite communication network, the network comprising:

a satellite constellation, the satellite constellation comprising a plurality of communication satellites, each of the communication satellites deployed in a geostationary earth orbit (GEO); and

one or more terrestrial transceivers, the one or more terrestrial transceivers comprising:

a patch antenna sensitive to signals within an L-Band RF range, the patch antenna comprising a metallic reflector;

at least one printed circuit board assembly (PCBA) comprising a dielectric substrate, at least one electronic component disposed upon the dielectric substrate, and a hole penetrating the dielectric substrate;

a modulator/demodulator (modem) communicatively coupled to the patch antenna and operable for modulating and for demodulating RF signals; and

a coupler assembly, wherein the coupler assembly comprises:

a pair of pins, each comprising a conductive material, wherein the pair of pins is operable for coupling signals within an RF range between the patch antenna and the at least one electronic component of the at least one PCBA;

a screen cover comprising a conductive material and operable for providing a ground connection between the modem and a ground plane of the patch antenna; and

at least one spacer comprising a dielectric material.

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